From Recussitation to Birth: Double Valve Replacement Due to Infective Endocarditis in Pregnant Woman

Resusitasyondan Doğuma: Gebe Bir Kadında Enfektif Endokardite Bağlı Çift Kapak Replasmanı

Çift Kapak Replasmanı / Double Valve Replacement

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Özet

Kalp hastalığı bulunan hastalarda gebelik anne ve fetus artmış bir risk taşır. Bu yazıda gebeliğinin 16. haftasında resusite edilen ve uzun kardiyopulmoner bypass zamanları ile (112 dakika kros-klemp ve 133 dakika perfüzyon zamanı) enfektif endokardit ve dekompanse kalp yetmezliği nedeniyle çift kapak replasmanı uygulanan bir hasta sunulmaktadır. Cerrahiden sonra hastamız birinci ve beşinci dakika Apgar skoru 9 olan sağlıklı bir bebek dünyaya getirmiştir. Gebelik sırasında kalp cerrahisi kabul edilebilir maternal ve fetal mortalite oranları ile uygulanabilir. Cerrahi ve sonrası dönemde sıkı protokollere uyulursa, bu oranlar daha da azaltılabilir.

Anahtar Kelimeler

Gebelik; Kalp Cerrahisi; Kardiyopulmoner Bypass

Abstract

Pregnancy carries an increased risk for mother and the fetus in patients with cardiac disease. In this case we represent a woman with gestational age of 16 weeks, who was resuscitated and underwent double valve replacement with longer cardiopulmonary bypass times (112 minutes of cross clamping and 133 minutes of perfusion time) due to infective endocarditis and decompensed heart failure. After the surgery at 38th gestational weeks, she gave birth uneventfully to a healthy child whose Apgar score was 9 at first and fifth minutes of the delivery. Heart surgery during pregnancy can be performed with acceptable maternal and fetal mortality rates. These rates may even be lower if strict protocols performed during every step of surgery and after.

Keywords

Pregnancy; Cardiac Surgery; Cardiopulmonary Bypass

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Introduction

The incidence of heart diseases in pregnant women ranges from 1% to 4% and rheumatic mitral disease is responsible for most cases (50%)(1-3). Some of these patients evolve into decompensation and require either surgery or interventional treatment during pregnancy (4).

Women with underlying rheumatic heart disease, even if well compensed, can easily progress to acute heart failure by cardio respiratory requirements during pregnancy. Pregnancy creates a burden on cardiovascular system and result in decompensation in women with underlying cardiac disease. To minimize the maternal and fetal risks, the first choice of treatment should be medical. In cases that are refractory to medical treatment, however, corrective cardiac operations should be undertaken in order to save mother's life (1,2).

Because cardiac surgical morbidity and mortality in the parturient is higher than nonpregnant patients, most parturients with cardiac disease are first managed medically, with cardiac surgery being reserved when medical management fails. Risks to the fetus during maternal cardiac surgery are high, with reports of fetal morbidity and mortality as high as 9% and 30%, respectively (5).

Surgery in pregnant woman was initially described without extracorporeal circulation by Block in1952 (6). In 1959, Dubourg and associates described surgical correction of Fallot's tetralogy using extracorporeal circulation to correct cardiac diseases during pregnancy (7). Others reported the use of this technique to treat other pathologies in pregnant women, such as aortic stenosis (8), mitral valve replacement (9), myocardial revascularization (10), and removal of left atrial myxoma (11).
Pregnant women who have cardiac operations requiring cardiopulmonary bypass (CPB) must face a non-physiologic hemodynamic status where the tolerance is not clearly known, which can adversely affect both the mother and fetus (12, 13). Cardiopulmonary bypass has many potential side effects, including alteration of the cellular protein components of blood as well as coagulation, vasoactive substance release from leukocytes, complement activation, particulate and air embolism, non-pulsatile flow, hypotension, and hypothermia. All of these factors can hamper uteroplacental perfusion and fetal development. Furthermore, cannulation of the inferior vena cava can obstruct the blood flow and cause reduced right ventricular filling and resultant alterations in placental perfusion (13, 14). The effects of the pump and perfusate type used during CPB and the duration of perfusion on maternal and fetal outcome are well recognised. Theoretically, factors related to CPB such as nonpulsatile perfusion, hyperoxygenation, and heparinization may have adverse effects on the placenta and the fetus (15).

Most studies of cardiac operations during pregnancy are case presentations, at times organized as literature reviews (1, 13, 15-18). In our case presentation, we interpreted a case who was resuscitated from cardio respiratory arrest at 16 weeks of gestation due to mitral stenosis and aortic stenosis and after follow up, she had aortic and mitral valve replacement.

Case Report

A 27 year old pregnant woman was followed medically with the diagnosis of rheumatic valvular (mitral and aortic valves) heart disease. She was 1,68 m tall and weighed 47 kg. At the 16 weeks gestation she was admitted to cardiology department of our hospital with the complaints of palpitation, pretibial edema (++/++) and dyspnea. Echocardiography revealed vegetations on mitral valve. She was admitted to the clinic with the diagnosis of infective endocarditis and decompensated heart failure. She was put on medical therapy against endocarditis (antibiotherapy was consulted with department of infectious disease with the proliferation of S. bovis at the cultures) and heart failure. Then she had cardio respiratory arrest as a result of an episode of acute pulmonary edema at the coronary intensive care unit. She was entubated and resuscitated. After 10 minutes of resuscitation, she replied to therapy and returned with a sinus rhythm. When she returned with the applied resuscitation, fetal heart rate was checked by an obstetrician immediately. The obstetrician declared no problem with fetus and the placenta. This situation was also consulted with the family. The family did not want the termination of pregnancy. After she awakened she also wanted the same. With this consent, she was advised to urgent surgical valve replacement.

She was admitted to cardiovascular surgery clinic four days later after cardiac arrest. Her physical examination revealed 2/6 systolic and 1/4 diastolic murmur at the mesocardiac area. At the transesophageal echocardiography there was pericardial effusion, pleural fluid, pulmonary hypertension (113 mmHg), mitral stenosis (valve area <1 cm2), 30 tricuspid insufficiency, 20 aortic failure, vegetation on mitral valve anterior leaflet. Medication against infective endocarditis and acute pulmonary edema were continued. The obstetricians and the cardiovascular surgeon consulted the patient and they finally agreed in the surgery decision. The obstetrician determined the fetal development was within normal limits. Aortic and mitral valve replacement was planned.

After preparations for an open heart procedure, a cardiotocoghraph was positioned externally by an obstetrician, and the fetal heart rate (FHR) was found to be 150 beats per minute and rhythmic. Surgery was performed under general anesthesia. Entubation was facilitated with No:7 ETT following the injection of thiopental (5 mg/kg), fentanyl (5 µg/kg), vecuronium (0.1 mg/kg). Anesthesia was maintained with O2:Air (50%-50%) and 2 % MAC sevoflurane inhalation. Fentanyl and vecuronium boluses were done when required according to half-time of the drugs. To prevent uterin contractions epanutin and ritadrin infusions were used during the whole procedure. Cardiopulmonary bypass was initiated after the cannulation of the aorta and the vena cava following the full heparinization (ACT > 450 seconds), and it was standardized using crystalloid prime. As CPB initiated fetal heart rate decreased and returned to normal limits with the increase of CPB flow. Systemic mild hypothermia (30-32 oC) was established. The prime solution was composed of the following: 1500 ml Ringer lactate solution, 20 mmol of sodium bicarbonate, and 50 mg (5000 IU) heparin. After the aortic cross-clamp was applied, hyperkalemic buffered cold crystalloid cardioplegic solution was infused into the aortic root at 10 mL per kilogram of body weight. After surgical examination, her mitral valve was replaced with a 27 mm St. Jude mechanical valve; and her aortic valve was replaced with a 19 mm St. Jude mechanical valve. The patient was rewarmed. Cardiac activity resumed after a single defibrillation. Aortic cross-clamp time was 112 minutes and total cardiopulmonary bypass time was

133 minutes. After she was weaned from CPB, protamine was administered according to the activated clotting time measurements. The patient was taken to the intensive care unit (ICU). One hour after the patient's admission to ICU; the obstetrician evaluated the patient and found the FHR to be within normal range and rhythmic. Postoperative period was uneventful. Because of the mechanical prosthetic valve replacement, the patient put on an anticoagulation regimen with low molecular weight heparin (LMWH). Before hospital discharge, the patient learned to give self injections of LMWH (enoxaparine 0.4 cc, Sanofi Aventis, France) twice a day. On follow-up, no maternal or fetal complications caused by LMWH were observed. At 38 weeks of gestation, LMWH was stopped 12 hours before planned delivery. The patient subsequently underwent elective Cesarean section under general anesthesia. She delivered a healthy female infant, with Apgar scores of 9 at 1 minute, and 9 at 5 minutes post-delivery.

At delivery, hemostasis was deemed adequate, and LMWH was again started by 24 hours. Mother and child were followed by cardiovascular surgeons and pediatricians as outpatients, and at last check-up the child at 9 months was developing normally.

Discussion

Organic heart disease, with an incidence of 1 % to 4 %, is the primary cause of maternal fetal death during pregnancy. The underlying cause is rheumatic heart disease in 60 % of these cases, and mitral stenosis is the most frequent diagnosis (13,19-22).

Cardiovascular maternal morbidity and mortality during pregnancy correlate strongly with maternal functional status.Four major risk factors predict adverse maternal outcomes: 1)a history of transient ischemic attack,stroke, or arrhythmia; 2) a NYHA heart failure classification of three or four before onset of pregnancy; 3)left-heart obstruction (e.g.,mitral valve area < 2 cm2, aortic valve area < 1,5 cm2, peak left outflow gradient > 30 mm Hg); and 4) a left ventricular (LV) ejection fraction < 40%. When more than one risk factor is present, the incidence of maternal complications increases to nearly 75%. Common complications include pulmonary edema, arrhythmias, myocardial infarction, cardiac failure, stroke and death (5).

Table 1. Common perioperative drugs and their effects in early pregnancy's

Medication	Effects on early gestational fetus	Safety profile
Diazepam	Oral clefts with prolonged usage	D
Midazolam	Not known	C
Propofol	Not known	B
Thiopental	Not known	B
Etomidate	Embryocidal in large doses in animal studies	C
Ketamine	Unknown, recommended not to be used in first trimester	D
Fentanyl,morphine	Not known	B
Neuromusculer blockers	Safe for clinical use as they do not cross the placental barrier in significant amounts	C
Epinephrine/dopamine[a]	Not known	C
Vasopressin	Not known	C
Ephedrine[b]	Not known	C
Phenylephrine[b]	Minor defects reported	C
Atropin	Minor malformation possible	C
Anticoagulants		
Warfarin[c]	Congenital malformations	D
Heparin[d]	None reported	B

Food and Drug Administration Drug Risk Classification:A, Controlled studies show no risk; B, No evidence of risk,either animal studies show risk, but humans do not, or animal studies do not show risk and no adequate human studies; C, Studies in pregnant women are lacking and animal studies are positive or lacking; D, Positive evidence for risk

[a]Epinephrine and dopamine have been used safely in pregnant patients.

[b]Vasopressors of choice for pregnant patients with hypotension.

[c]Warfarin is contraindicated in the first trimester.

[d]Heparin does not cross the placental barrier and does not affect the fetus.

Most of the pregnant women with mild to moderate mitral stenosis can tolerate the burden on the cardiovascular system caused by pregnancy. However, in cases with moderate to severe lesions, complications, such as pulmonary venous congestion, pulmonary edema, right ventricular dysfunction, pulmonary hypertension, hemoptysis, atrial fibrillation, systemic or pulmonary embolism, and infective endocarditis, can occur during pregnancy.

The chief concern in the anesthetic management of patients with mitral stenosis is to avoid tachycardia and prevent any increases in PAP. Conditions or substances that increase pulmonary vascular resistance (e.g, hypercarbia, hypoxia, and nitrous oxide) are to be avoided to maintain cardiac output.

Extracorporeal circulation is an important technique that causes significant alterations in the mother and fetus. CPB causes alterations in coagulation, the release of vasoactive substances, activation of the complement system, air and particulate emboli, non-pulsatile flow, hypotension, and hypothermia (1,2). Hypothermia may lead to uterine contractions and reduction of placental flow (17). To reduce these risks, extracorporeal circulation with high flow, high pressures (mean blood pressure of 60 mmHg), and normothermia should be used (15,18). Hyperoxygenation should be maintained and hematocrit should be kept higher than 25 %.

In 1958, Leyse and colleagues (8) first used CPB in a heart operation during pregnancy. After the initial trials, pregnant women have been recognized to tolerate CPB as well as non-pregnant women, but the effects of CPB on the fetus have varied (12, 15, 23). Pomini and cooleagues (18) evaluated 69 women who had cardiac operations with CPB during pregnancy and found the embryo-fetal mortality rate to be 24 % under hypothermic conditions versus 0 % under normothermic conditions. They also found that maternal mortality rates did not differ at different temperatures. Younger gestational age and a greater degree of hypothermia are known to increase fetal morbidity during CPB (14).

Although fetal bradycardia is known to develop frequently during the initiation of extracorporeal circulation and to normalize immediately after CPB (24-27), abnormal FHR was reported not to return to normal value and continue for several hours postoperatively (28). Fetal bradycardia can be caused by fetal hypoxia or acidosis, maternal hypothermia, or administration of drugs such as propranolol through the placenta. Fetal hypoxia can be caused by reduced uterine perfusion pressure, or increased uterine arterial resistance (14). Like fetal bradycardia, compensatory tachycardia that frequently follows fetal distress is also reported to indicate fetal hypoxia (17).

Successful CPB for cardiac surgery during pregnancy has been reported, but experience is still limited. In the literature there were some CPB and cross clamping times between 37-105/27-33minutes (CPB/cross-clamp time). (1, 4, 29-31) In this case since double valve replacement was performed, the cross clamping and the CPB time were longer than the literature. Despite these longer periods there was no problem with the fetus.

The effects of many drugs commonly used during the perioperative period are shown in Table 1. Fetal protection strategies during CPB are as follows: During CPB, a high pump flow rate (>2,5 L.min-1.m-2) and perfusion pressure (>70 mmHg) are recommended to maintain uterin blood flow (UBF). Additionally, it is recommended that the maternal hematocrit be maintained >28% to optimize oxygen-carrying capacity. In one series, fetal mortality was 24% vs 0% when hypothermic versus normothermic CPB was compared respectively. Thus, normothermic perfusion during CPB is recommended when feasible. Although controversial, pulsatile flow may also better preserve UBF. Finally, changes in the CO2 tension can also affect UBF. Specifically, hypocapnia causes uteroplasental vasoconstruction and hypercapnia increases UBF.Therefore, α-stat pH management may be advantageous for maintenance of CO2 homeostasis and UBF.

Heart disease is the primary cause of nonobstetric mortality in pregnancy. Women at increased risk for morbidity in pregnancy include those with a prior stroke or arrhythmia, NYHA heart failure classification > 2, anticogulation use during pregnancy, smoking, multipl gestation, and left heart obstruction. Because cardiac surgical morbidity and mortality in the parturient is higher than nonpregnant patients, most parturients with cardiac disease are first managed medically, with cardiac surgery being reserved when medical management fails. Risk factors for fetal mortality include maternal age >35 yr, functional class, reoperation, emergency surgery, type of myocardial protection, and anoxic time (5).

In this pregnant patient undergoing mitral and aortic valve replacement, successful perioperative management included careful selection of anesthetic and supportive agents, prevention of pulmonary edema, intensive treatment of congestive heart failure just before and during induction, continuous cardiotocographic monitoring, high CPB perfusion pressures, pulsatile high flow during CPB, and avoidance of deep hypothermia. Although it is generally advised to minimize the CPB and the cross-clamping time, longer durations of perfusion can safely be performed with high perfusion pressures and flow rates. Continuation of pregnancy and delivery should be considered, when there is no problem with fetal and maternal health.

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